ISSN 1314-6246 Stoykov *J. BioSci. Biotech.* **2020**, 9(1): 69-76
RESEARCH ARTICLE

Dimitar Stoykov

Lichen-forming fungi from Rilomanastirska Gora Reserve, Rila Mts (Bulgaria)

Authors' addresses:
Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, 2 Gagarin Str.,1113, Sofia, Bulgaria.

Correspondence:
Dimitar Stoykov
Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, 2 Gagarin Str.,1113, Sofia, Bulgaria.
Tel.: +359 29793715
e-mail: stoykovdimitar@abv.bg

Article info:
Received: 7 June 2020
Accepted: 23 June 2020

ABSTRACT
Forty nine species are added to enrich the known lichen diversity within the Rilomanastirska Gora Reserve as a result of field and laboratory studies. Among them, *Pertusaria amara* and *Opegrapha rufescens* are new records for Rila Mts. Two species (*Sticta sylvatica* and *Lobaria pulmonaria*) are of conservation value. Data on some rarely recorded species in Bulgaria are briefly discussed.

Key words: Bulgaria, lichen mycota, protected area, Rilomanastirska Gora

Introduction

The Rilomanastirska Gora Reserve is a part of Rila National Park. It was declared in 1986 with a total area of 3676.5 ha, designated to protect the native forest ecosystems of coniferous and mixed fir and beech forests. This reserve includes the alpine zone and forest formations on both sides of the Rilska River, between Malyovitsa peak, Orlovets peak, Suhoto Lake, Dzhendemski Dol stream and Brichebor peak. There are typical to the reserve area the mixed broadleaf-coniferous forests, with the presence of *Abies alba* Mill. and *Fagus sylvatica* L. Rila oak (*Quercus protoroburoides*) forests are unique in the country, known from three localities in the valley of Rilska River, with one of them situated on slopes above the Ilijna River (Roussakova 2015). *Pinus mugo* Turra communities dominated in the subalpine belt.

This work reports data on the species diversity of lichen-forming fungi on the territory of Rilomanastirska Gora Reserve (Rila Mts). First contributions about the lichen-forming fungi from the reserve area are considered the works of Kazandzhiev (1900) and Suza (1929) recorded about 26 species, mostly from the vicinities of the Rilski monastery. Subsequently, Zhelezova (1956, 1960, 1963; Motyka & Zhelezova 1962) made consecutive contributions on the species diversity of the lichen mycota in Bulgaria and established 26 species from the reserve. Data on the lichen records from the region of the Rilski monastery could be obtained also in Popnikolov & Zhelezova (1964). Single collections from the reserve area were examined more recently by Pišút (1995, 2001). Seven new species to the Rilomanastirska Gora Reserve from *Physciaceae* family were discovered by Atanassova & Mayrhofer (2012). Summarized information about the ecology and the known distribution of *Lobaria pulmonaria* (L.) Hoffm. in Bulgaria and within the reserve area, based on additional data from specialized collections was published in Stoykov (2015). Prior to the present studies, 56 species (including 1 subspecies, 3 varieties, and 2 forms), belonging to 33 genera from the reserve area, were known (Table 1).

Materials and Methods

The following work aimed to contribute to the lichenized fungi, collected on the territory of the reserve in different broadleaf, coniferous and mixed forest habitats. Method of linear transects for collecting of lichen-forming specimens was used, and some specimens housed at the Mycological Collection of the Institute of Biodiversity and Ecosystem Research (SOMF) were examined. Field trips were carried out in 2015. The study areas included: tourist trail from Rilski monastery in directions from Kalugerski Dol river towards Ivan Vazov chalet; region above Ilijna river with mixed broadleaf Rila oak and beech forests; forest trail to Bricheborski Dol river and Vtoroto Pochivalo below Brichebor peak; Kirilova Polyana locality, on the trail to Suhoto Ezero lake, and in the old beech forest mixed with single fir trees, below Kirilova Polyana, above the road to Rilski monastery) vicinity of St. Luka chapel. The determination of the examined materials was made generally after Dobson (2000, 2011, 2013), Nimis et al. (2009) and Atanassova & Mayrhofer (2012), using standard

Table 1. *Lichen-forming fungi known from Rilomanastriska Gora Reserve*

Taxon	Author
Arthonia radiata	Suza, 1929; Popnikolov & Zhelezova, 1964
Alectoria sarmentosa	Zhelezova 1956
Anaptychia ciliaris	Atanassova & Mayrhofer, 2012
Bacidia rosella	Popnikolov & Zhelezova, 1964
Candelariella xanthostigma	Zhelezova, 1963
Chaenotheca chrysocephala	Zhelezova, 1963
Cladonia cenotea, C. ochrochlora	Zhelezova, 1963; Popnikolov & Zhelezova, 1964
Collema flaccidum, C. nigrescens, C. occultatum	Suza, 1929; Zhelezova, 1963; Popnikolov & Zhelezova, 1964
Dermatocarpon miniatum var. *complicatum, D. miniatum* var. *miniatum*	Zhelezova, 1963
Diploschistes muscorum	Suza, 1929; Popnikolov & Zhelezova, 1964
Graphis scripta	Suza, 1929
Lecidea lapicida var. *lapicida*	Suza, 1929
Lepraria membranacea	Suza, 1929
Leptogium lichenoides	Suza, 1929
Lobaria amplissima, L. pulmonaria f. *papillaris*; *L. pulmonaria* f. *pulmonaria, L. scrobiculata*	Suza, 1929; Zhelezova, 1956, 1963; Stoykov, 2015
Melanelia fuliginosa subsp. *glabratula, M. glabra*	Suza, 1929; Zhelezova & Popnikolov, 1964
Nephroma parile, N. resupinatum	Suza, 1929; Zhelezova, 1963
Ochrolechia alboflavescens, O. pallescens, O. szatalaensis	Zhelezova, 1963; Popnikolov & Zhelezova, 1964; Pišút, 1995
Parmelina carporrhizans	Zhelezova, 1956; Popnikolov & Zhelezova, 1964
Pannaria conoplea	Suza, 1929
Peltigera didactyla, P. lepidophora, P. polydactylon, P. praetextata, P. rufescens, P. venosa	Suza, 1929; Zhelezova 1956, 1960, 1963
Pertusaria leioplaca	Pišút, 2001
Physcia aipolia, P. caesia, P. dubia, P. stellaris	Atanassova & Mayrhofer, 2012
Physconia distorta, P. grisea, P. perisidiosa	Zhelezova, 1956; Atanassova & Mayrhofer, 2012
Placidium rufescens, Polychidium muscicola	Suza, 1929
Pseudevernia furfuracea	Zhelezova, 1956
Pyrenula coryli, P. nitida	Suza, 1929
Rhizocarpon viridiatrum	Suza, 1929; Popnikolov & Zhelezova, 1964
Sticta sylvatica	Suza, 1929
Usnea filipendula, U. glabrescens, U. scabrata, U. substerilis, U. subfloridana	Kazandzhiev, 1900, Motyka & Zhelezova, 1962
Xanthoria fallax	Zhelezova, 1963

lichenological techniques. The nomenclature of the species from the reserve area follows Mayrhofer et al. (2005). The classification system of the lichen-forming fungi presented in Appendix 1. Table 2 is accepted after Lumbsch & Huhndorf (2010) and is in accordance with the changes, proposed in the latest '*Outline of Ascomycota*' by Wijayawardene et al. (2018). The most recent records of *Lobaria pulmonaria* and *L. scrobiculata* (Scop.) DC in the reserve, made during the present field studies, were published in Stoykov (2018a), and some of their location points were used in Appendix 1. Table 2.

Results and Discussion

The species diversity of the lichen-forming fungi in Rilomanastirska Gora Reserve is relatively rich. The most important microhabitats for lichens are old trees (mostly beech, oak and conifers), rocks, often covered by mosses, and soil. According to the known published data and the results obtained from the examined materials (Appendix 1. Table 2), 105 species (almost 9.5 % of the known species diversity of Bulgaria), including 1 subspecies, 3 varieties, and 2 forms of the lichen-forming fungi are presented on the territory of the

RESEARCH ARTICLE

Appendix 1. Table 2. *Diversity of the lichen-forming fungi of Rilomanastirska Gora Reserve. **
*******The lichen taxa, studied with herbarium materials are designated in the second column with a symbol (+).*

Taxon	Location	Host/Substratum
Ascomycota		
Pezizomycotina		
Arthoniomycetes		
Arthoniales		
Arthoniaceae		
Arthonia radiata (Pers.) Ach.	+, N42°07′53″, E023°19′31″	bark of hazel and other broadleaf trees
Rocellaceae		
Opegrapha rufescens Pers.	+, above Bricheborski Dol river, alt. 1650 m	bark of old pine trees
Coniocybomycetes		
Coniocybales		
Coniocybaceae		
Chaenotheca chrysocephala (Turner ex Ach.) Th. Fr.	+	bark of conifers
Eurotiomycetes		
Chaetothyriomycetidae		
Pyrenulales		
Pyrenulaceae		
Pyrenula coryli A. Massal.		bark of hazel
Pyrenula nitida (Weigel) Ach.	+, N42°07′46″, E023°19′31″	bark of beech
Verrucariales		
Verrucariaceae		
Dermatocarpon miniatum (L.) W. Mann var. *complicatum* (Lightf.) Th. Fr.		eruptive rocks
D. miniatum (L.) W. Mann var. *miniatum*	+, N42°07′57″, E023°19′55″	siliceous and limestone rocks
Placidium rufescens (Ach.) A. Massal.		gneises
Lecanoromycetes		
Candelariomycetidae		
Candelariales		
Candelariaceae		
Candelariella vitellina (Hoffm.) Müll. Arg.	+	rock
C. xanthostigma (Ach.) Lettau	+	trunk of *Abies alba*, bark of old trees
Lecanoromycetidae		
Lecanorales		
Cladoniaceae		
Cladonia cenotea (Ach.) Schaer.	+	rotten trunks of conifers
C. coniocraea (Flörke) Spreng., s.l.	N42°06′30″, E23°20′34″; N42°07′56″, E023°21′20″, Stoykov 2018a	bark of trees
C. ochrochlora Flörke		soil, among mosses
C. pyxidata (L.) Hoffm.	+, above Bricheborski Dol river, towards Vtoro Pochivalo below Brichebor peak	mossy rocks
C. fimbriata (L.) Fr.	N42°07′47″, E023°19′31″, Stoykov 2018a	soil, among moss
Lecanoraceae		
Lecanora albella (Pers.) Ach.	+	bark of broadleaf tree
L. carpinea (L.) Vain.	+, N42°07′53″, E023°19′31″	twigs of broadleaf trees
L. gangaleoides Nyl.		rock
Lecidella elaeochroma (Ach.) M. Choisy	+	bark of beech
Lecideales		
Lecideaceae		
Porpidia crustulata (Ach.) Hertel & Knoph, s.l.	+	siliceous rock

Parmeliaceae		
Alectoria sarmentosa (Ach.) Ach.		branches of *Abies alba*
Bryoria capillaris (Ach.) Brodo & D. Hawksw., s.l.	+, N42°08′06″, E023°21′24″	twigs of conifers
B. fuscescens (Gyeln.) Brodo & D. Hawksw., s. l.	+	twigs of conifers
B. subcana (Nyl. ex Stizenb.) Brodo & D. Hawksw., s.l.	+	twigs of conifers
Cetraria islandica (L.) Ach.	+	soil, among mosses
Evernia divaricata (L.) Ach.	+	twigs and bark
E. prunastri (L.) Ach.	+	twigs and bark
Flavoparmelia caperata (L.) Hale	+	twigs and bark
Hypogymnia physodes (L.) Nyl.	+, N42°06′33″, E023°20′28″	twigs
H. tubulosa (Schaer.) Hav.	N42°07′46″, E023°19′31″, Stoykov 2018a	twigs
Melanelia fuliginosa (Fr. ex Duby) Essl. subsp. *glabratula* (Lamy ex Nyl.) Coppins	+, N42°07′46″, E023°19′31″	trunks of trees, on rocks and mosses
Melanelia glabra (Schaer.) Essl.		*Prunus cerasifera* Ehrh.
Parmelia saxatilis (L.) Ach.	+	rocks
P. sulcata Taylor	+, Stoykov 2018a	twigs
Parmelina carporrhizans (Taylor) Poelt & Vězda	+	twigs
P. quercina (Willd.) Hale	+, Stoykov 2018a	twigs
Platismatia glauca (L.) W.L. Culb. & C.F. Culb.	+	twigs of conifers
Pseudevernia furfuracea (L.) Zopf	+	twigs and bark
Usnea filipendula Stirt.		twigs and bark
U. florida (L.) F.H. Wigg. emend. Clerc, s.l.	+	twigs and bark
U. glabrescens (Vain.) Vain.		twigs and bark of spruce, oak
U. hirta (L.) Weber ex F.H. Wigg., s.l.	+, Stoykov 2018a	twigs and bark of oak
U. scabrata Nyl.	+	twigs and bark of oak (*Quercus petraea* (Mattuschka) Liebl.)
U. subfloridana Stirt.		twigs and bark of oak
U. substerilis Motyka		*Abies alba*, *Betula*, *Pinus sylvestris*
Vulpicida pinastri (Scop.) J.-E. Mattsson & M.J. Lai	+	trunks and bark of conifers
Ramalinaceae		
Bacidia rosella (Pers.) De Not.		bark of broadleaf trees
Ramalina calicaris (L.) Fr.	+, N42°07′52″, E023°19′35″	bark of trees
R. farinacea (L.) Ach.	+, N42°07′52″, E023°19′35″, Stoykov 2018a	bark of trees
R. fraxinea (L.) Ach.	+, N42°07′52″, E023°19′35″	bark of trees
Stereocaulaceae		
Lepraria incana (L.) Ach., s.l.	+, N42°07′52″, E023°19′35″, Stoykov 2018a	soil among mosses, bark of trees
L. membranacea (Dicks.) Vain.		gneises, among mosses
Peltigerales		
Collemataceae		
Collema flaccidum (Ach.) Ach.	+	granite rock with mosses
C. nigrescens (Huds.) DC.		*Prunus cerasifera* Ehrh., beech
C. occultatum Bagl.		trees
Leptogium lichenoides (L.) Zahlbr.		gneises
L. gelatinosum (With.) J.R. Laundon	+, Stoykov 2018a	mossy bark of old tree
Lobariaceae		
Lobaria amplissima (Scop.) Forssell		trunk of beech
L. pulmonaria (L.) Hoffm. f. *papillaris* (Delise) Hue	+, N42°09′11″, E023°24′1″, Stoykov 2018a	trunks and bark of beech
L. pulmonaria (L.) Hoffm. f. *pulmonaria*	N42°07′53″, E023°19′24″, 1436 m; maple, N42°07′56″, E023°19′30″, 1354 m; oak, N42°06′26″, E023°20′38″, Stoykov 2018a	bark of oak, beech

L. scrobiculata (Scop.) DC.	+, N42°06′30″, E023°20′16″, Stoykov 2018a	gneises; mossy rocks, trunk of old beech
Sticta sylvatica (Huds.) Ach.		mossy gneises
Massalongiaceae		
Leptochidium albociliatum (Desm.) M. Choisy		rocks and mossses
Polychidium muscicola (Sw.) Gray		mosses
Nephromataceae		
Nephroma laevigatum Ach.	+, after Bricheborski Dol river, N42°07′53″, E023°21′28″	trunk of old beech
N. parile (Ach.) Ach.	+, Kirilova Polyana	bark of beech
N. resupinatum (L.) Ach.	+, Kirilova Polyana	bark of beech, on soil among mosses, mossy rock
Pannariaceae		
Pannaria conoplea (Ach.) Bory		mossy gneisses
Protopannaria pezizoides (Weber) P.M. Jørg. & S. Ekman	+, along the trail to Ivan Vazoh chalet	bark of beech
Peltigeraceae		
Peltigera canina (L.) Willd.	+	soil, among mosses
P. didactyla (With.) J.R. Laundon		rocks
P. lepidophora (Nyl. ex Vain.) Bitter		soil
P. polydactylon (Neck) Hoffm.		gneises
P. praetextata (Flörke) Vain.		granite rock, mossy bark of beech
P. rufescens (Weiss) Humb.		rotten trunk
P. venosa (L.) Hoffm.	+, N42°08′03″, E023°21′15″	soil, among mosses,
Rhizocaprales		
Rhizocarpaceae		
Rhizocarpon geographicum (L.) DC.	+	siliceous rocks
R. viridiatrum (Wulfen) Körb.		siliceous rocks
Teloschistales		
Caliciaceae		
Amandinea punctata (Hoffm.) Coppins & Scheid.	+, N42°07′52″, E023°19′36″	bark of beech
Calicium viride Pers.	+, Kirlova Polyana, alt. ca 1200 m.	bark of fir
Physciaceae		
Anaptychia ciliaris (L.) Körb.	+, N42°07′48.5″, E023°19′50″; oaks, N42°06′24″, E023°20′39″, N42°06′34″, E023°20′31″, Stoykov 2018a	bark of spruce and old beech trees
Physcia aipolia (Humb.) Fürnr.	+, N42°07′48.5″, E023°19′50″	bark of beech, oak
P. caesia (Hoffm.) Fürnr.		siliceous rock
P. dubia (Hoffm.) Lettau		siliceoius rock
P. stellaris (L.) Nyl.		bark of beech, oak
Physconia distorta (With.) J.R. Laundon	N42°06′24.5″, E023°20′39″, Stoykov 2018a	bark and dead branches of beech, *Quercus robur* L., oaks
P. grisea (Lam.) Poelt		bark of spruce
P. perisidiosa (Erichsen) Moberg		deciduous branches
Rinodina sophodes (Ach.) A. Massal.	+, N42°07′51″, E023°19′30″; N42°06′34″, E023°20′31″	bark and twigs of beech
Teloschistaceae		
Xanthoria fallax (Hepp) Arnold		bark of spruce
Ostropomycetidae		
Ostropales		
Graphidaceae		
Diploschistes muscorum (Scop.) R. Sant.		moss on rocks
Graphis scripta (L.) Ach.	N42°07′51″, E023°19′56″	bark of trees
Porinaceae		
Pseudosagedia aenea (Wallr.) Hafellner & Kalb.	after Kalugerski Dol river	branches of smooth-bark trees

Pertusariales		
Megasporaceae		
Aspicilia cinerea (L.) Körb., s.l.	+, after Kalugerski Dol river	rock
Ochrolechiaceae		
Ochrolechia alboflavescens (Wulfen) Zahlbr.		bark of *Abies alba*
O. pallescens (L.) A. Massal.	+, N42°06′34″, E023°20′31″	bark of beech, *Sorbus* sp.
O. szatalaensis Verseghy		bark of beech
Pertusariaceae		
Pertusaria albescens (Huds.) M. Choisy & Werner [= *Lepra albescens* (Huds.) Hafellner]	+, N42°06′33″, E023°20′28″, Stoykov 2018a	bark of oak trees
P. amara (Ach.) Nyl. [= *Lepra amara* (Ach.) Hafellner]		bark of beech trees
	+, N42°06′33″, E023°20’28”	
	+, near the trail from Kalugerski Dol river to Ivan Vazov hut	bark of old beech tree
P. hemisphaerica (Flörke) Erichsen		
	+, N42°07′51″, E023°19′56″, N42°07′49″, E023°19’49’’	bark of beech
P. flavida (DC.) J.R. Laundon		
P. lactea (L.) Arnold	+, N42°06′33″, E023°20′28″	rock
	+, N42°07′52″, E023°21′37″; N42°09′29″, E023°23′48″	bark of beech
P. leioplaca DC.		
	+, N42°06′28″, E023°20′20″, N42°08′06″, E023°21′17″	bark of beech
P. pertusa (Weigel) Tuck.		
Trapeliales		
Trapeliaceae		
Xylographa parallela (Ach. : Fr.) Fr.	+, N42°07′47″, E023°21′35″	decorticated dead conifer tree
Umbilicariomycetidae		
Umbilicariales		
Umbilicariaceae		
Lasallia pustulata (L.) Mérat	+, N42°06′33″, E023°20′30″	rock

Rilomanastirska Gora Reserve. They belong to 53 genera, 29 families, 13 orders, 5 subclasses (*Chaetothyriomycetidae*, *Candelariomycetidae*, *Lecanoromycetidae*, Ostropomycetidae, and Umbilicariomycetidae), and 4 classes (Arthoniomycetes, Coniocybomycetes, Eurotiomycetes, and Lecanoromycetes), subdivision Pezizomycotina, division Ascomycota. The species richness is found to be the highest in the class Lecanoromycetes (97 species); among the subclasses in Lecanoromycetidae (79 species), and Ostropomycetidae (15); among the orders in Lecideales (34 species), and Peltigerales (23); among the families in Parmeliaceae (26 species), Physciaceae (9), Peltigeraceae (7), and Pertusariaceae (7). The richest genera were Usnea (7 species), Peltigera (7), and Pertusaria, including Lepra (7); Cladonia (5), Physcia (4), Bryoria, Collema, Lecanora, Lobaria, Nephroma, Ochrolechia, Physconia, and Ramalina (3). Most probably the diversity of the lichen-forming fungi in that part of the Rila mountain is a result of its known complex habitat and microhabitat diversity, ecology, geographic location, unique surroundings, the presence of preserved old-growth forest communities, composed of coniferous and broadleaf (predominantly beech, Rila oak) trees, the peculiar geology of the reserve, and its specific environmental conditions (air humidity and atmospheric purity, mountain rivers and streams, unique temperature amplitudes, type of soils, rocks), etc.

During this study, we have observed the following species: *Alectoria sarmentosa*, *Calicium viride*, *B. fuscescens*, *B. subcana* s.l., *Chaenotheca chrysocephala*, *Cladonia cenotea*, *C. coniocraea*, *C. fimbriata*, *Evernia divaricata*, *Hypogymnia physodes*, *H. tubulosa*, *Opegrapha rufescens*, *Platismatia glauca*, *Pseudevernia furfuracea*, *Vulpicida pinastri*, *Xylographa parallela*, along with most of the species of genus *Usnea* Dill. ex Adans. with pendulous thalli, have ecological preferences to old-growth coniferous forests. Another group of species (*Arthonia radiata*, *Evernia prunastri*, *Melanelia fuliginosa* subsp. *glabratula*, *Lecanora albella*, *L. caprinea*, *Ochrolechia pallescens*, *Parmelia sulcata*, *Pertusaria amara* (=*Lepra amara* (Ach.) Hafellner), *P. albescens* (=*Lepra albescens* (Huds.) Hafellner), *P. hemisphaerica*, *P. flavida*, *P. pertusa*, *P. leioplaca*, *Pyrenula nitida*, *Pseudosagedia aenea*, *Ramalina fraxinea*, *R. calicaris*, *Usnea scabrata* and *U. subfloridana*) has preferences to broadleaf trees.

Arthonia radiata was reported in the region of Rilomanastirska Gora Reserve on the bark of hazel (Suza, 1929). It has been confirmed during this study on *Corylus avellana* L. along the trail from Kalugerski Dol river, in direction to Ivan Vazov chalet, and near St. Luka chapel, on bark of old deciduous trees. Recently this species has been recorded on bark of hazel and smooth-bark shrubs in Ibur

Reserve, Rila National Park (Gyosheva & Stoykov, 2019). It was reported from Vitosha, Rila and Rhodopi Mts (Mayrhofer et al., 2005). *Arthonia radiata*, along with *A. cinnabarina* (DC.) Wallr., is known to be common on young smooth-bark trunks in Great Britain (Rose, 1993).

Mention deserves the presence of thalli of *Calicium viride* studied with a single collection from the reserve area, based on a specimen collected from Kirilova Polyana locality on the bark of fir. In Bulgaria, it is known from the limited number of localities on the bark of old-aged coniferous trees (spruce, fir). The species was reported by Zhelezova (1956) along the road to Ribnite Ezera lakes on the bark of *Abies alba*. So far *C. viride* is known in the Pirin, the Rila and the Rhodopi Mts (Mayrhofer et al., 2005; Ivanov 2010). It has been recorded on old-aged spruce trees in the Central Rilski Reserve (Stoykov, 2018b).

Ochrolechia pallescens was reported from the following floristic regions: Stara Planina, Belasitsa, Pirin, Rila and Rhodopi Mts (Mayrhofer et al., 2005). It has been confirmed with herbarium material in SOMF on large branches of *Sorbus* sp. above the Ilijna River.

Opergrapha rufescens has been recorded in the Rilomanastirska Gora Reserve, above Bricheborski Dol river, on the trail to Brichebor peak, on the bark of very old pine trees at altitude 1650 m. It was known so far only from Central Balkan National Park and Strandzha Nature Park on the bark of oaks (Spier et al., 2008). Recently, it has been collected in the Balgarka Nature Park, Todorchetata village, on the bark of young walnut trees (Stoykov, unpubl.).

Pertusaria amara has been recorded on the bark of old beech trees from Kirilova Polyana locality and after Kalugerski Dol river in direction to Ivan Vazov chalet (Appendix 1. Table 2). The species was known so far in the Black Sea coast region, Stara Planina, Belasitsa and Strandzha Mts (Mayrhofer et al., 2005; Spier et al., 2008).

Pertusaria hemisphaerica has been found on the bark of old beech tree along the trail from the Kalugerski Dol river in direction to Ivan Vazov chalet. It was reported only from the following floristic regions: Black Sea coast, Belasitsa, Pirin and Rila Mts (Mayrhofer et al., 2005).

Pertusaria leioplaca was known on the slopes above Rilski monastery on *Fagus sylvatica* at 1200 m alt. (Pišút, 2001). The species has been recorded during this study on beech in the vicinities of Bricheborski Dol and Kalugerski Dol rivers and above Rilski monastery – St. Luka chapel locality, and near Kirilova Polyana locality. During 2014 it was collected on the bark of old beech trees in Rhodopi Mts – Mantaritsa Reserve, Pashino Burdo locality and in Strandzha Mts – Nature Park Strandzha, near Kondolovo village (Stoykov, unpubl.). It has been reported in Rila Mts from Ibur Reserve, along with *Pertusaria lactea* (L.) Arnold (Gyosheva & Stoykov, 2019).

Pseudosagedia aenea was known so far from the Black Sea region, Stara Planina (Boatin Reserve), Rila – Ibur Reserve and Strandzha mountains – Silkosiya Reserve (Popnikolov & Zhelezova, 1964; Spier et al., 2008; Gyosheva & Stoykov, 2019).

Xylographa parallela has been recorded on the decorticated bark of dead decorticated coniferous tree above Kirilova Polyana. It was known from the Stara Planina, Pirin, Rila and Rhodopi Mts (Mayrhofer et al., 2005).

Two lichens of conservation concern in Bulgaria were known from Rilomanastirska Gora Reserve, according to the data accepted in the National Strategy for protection of the biological diversity (Vodenicharov et al., 1993): *Sticta sylvatica* (Suza 1929), and following the criteria of the IUCN, *Lobaria pulmonaria* (Stoykov 2015, 2018a). Both species exist in single localities and are with restricted regional distribution throughout the country, furthermore the populations of the lung lichen decline in many European countries.

Polychidium muscicola could be considered as one of the rarely recorded species among the lichen-forming fungi of Bulgaria, because it is known so far only with single localities in the Rila Mts: Rilomanastirska Gora Reserve, above the Rilski monastery, at 1200 m alt. (Suza, 1929), Central Rilski Reserve, above Sarugyol hut, at 1990 m alt. (Stoykov, 2018b), and in the Rhodopi Mts: Smolyan and Chepelare (Szatala, 1930; Popnikolov & Zhelezova, 1964).

Acknowledgement

This study was conducted within the framework of 'Phylogeny, distribution and sustainable use of fungi' project. Mrs. Siyka Nikolova (Sofia, Bulgaria) is acknowledged for the determination of *Rinodina sophodes* collections. The author is grateful to the anonymous reviewers for their useful remarks.

References

Atanassova A., Mayrhofer H. 2012. *Physciaceae*. Part. 1. Foliose genera. – In: Denchev CM (ed), Fungi of Bulgaria. Vol. 9. Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Sofia.

Dobson FS. 2000. Lichens. An illustrated guide to the British and Irish Species. 4th revised colour Edition. Richmond Publishing Co, Slough.

Dobson FS. 2011. Lichens. An illustrated guide to the British and Irish species. 6th Edition. Richmond Publishing Co. Ltd., Slough.

Dobson FS. 2013. A Field Key to Lichens on Trees. New Maiden, Surrey.

Gyosheva MM, Stoykov DY. 2019. Macrofungi and lichen-forming fungi on the territory of Ibur Reserve, Rila National Park

(Bulgaria). Ann. Sof. Univ. "St. Kl. Ohridski", Faculty of Biology, Book 2 - Botany, 103: 38-48.
Ivanov D. 2010. Checklist of the lichens and lichenicolous fungi from the Pirin Mountains in Bulgaria. Ber. Nat.-Med. Verein Innsbruck, 96: 35-57.
Kazandzhiev S. 1900. Lichen flora of Bulgaria. Period. Spis. Bulg. Knizh. Drouzh., 61: 470-532. (In Bulgarian).
Lumbsch TH, Huhndorf SM. 2010. Part One. Outline of *Ascomycota*–2009. Fieldiana. Life and Earth Sciences. No. 1. Myconet, 14: 1-42.
Mayrhofer H, Denchev CM, Stoykov DY, Nikolova SO. 2005. Catalogue of the lichenized and lichenicolous fungi in Bulgaria. Mycol. Balcan., 2(1): 3-61.
Motyka J, Zhelezova B. 1962. A monographic study of Usnea in Bulgaria. Izv. Bot. Inst., 10: 67-120. (In Bulgarian)
Nimis PL, Wolseley P, Martellos S. 2009. A key to common lichens on trees in England. Key to Nature. Natural History Museum, London.
Pišút I. 1995. Interesante Flechtenfunde aus Mitte-, Süd- und Südosteuropa 2. – In: Farkas EÉ, Lücking R, Wirth V. (eds), Scripta Lichenologica. Lichenological papers dedicated to Antonın Vêzda. Bibl. Lichenol., 58: 281-287.
Pišút I. 2001. Beitrag zur Kenntnis der Flechten Bulgariens III. Acta Rerum Nat. Mus. Nat. Slovenici, 47: 21-26.
Popnikolov A, Zhelezova B. 1964. Flora of Bulgaria. Lichens. Narodna Prosveta, Sofia. (In Bulgarian)
Roussakova, V. 2015. 20G1 Rila oak (*Quercus protoroburoides*) forests. – In: Biserkov, V. et al. (eds), Red Data Book of the Republic of Bulgaria. Volume 3. Natural habitats. Bulgarian Academy of Sciences & MOEW, Sofia. p. 320-321. (In Bulgarian)
Rose F. 1993. Ancient British woodlands and their epiphytes. British Wildlife, 5: 83-93.
Spier L, van Doort K, Fritz Ö. 2008. A contribution to the lichen mycota of old beech forests in Bulgaria. Mycol. Balcan., 5(3): 141-146.
Stoykov DY. 2015. *Lobaria pulmonaria* (*Ascomycota*, *Lobariaceae*) in Bulgaria. Trakia J. Sci., Ser. Biomedical Sci., 13(2): 109-114.
Stoykov D. 2018a. Recent finds of *Lobaria pulmonaria* and *L. scrobiculata* in Bulgaria. – In: Chankova S, Danova K, Parvanova P. (eds), Proceedings of 10th Anniversary 'Seminar of Ecology – 2017', with international participation. 27-28 April, Sofia, Bulgaria. Farago, Sofia. p. 30-38.
Stoykov DY. 2018b. Addition to the lichenized fungi (*Ascomycota*) of Central Rilski Reserve (Rila Mts.). Ecol. Balkan., 10(2): 213-221.
Suza J. 1929. Lichenes Bulgariae, I. Acta Bot. Bohem., 8: 7-25.
Szatala Ö. 1930. Beiträge zur Flechtenflora von Bulgarien. II. Magyar Bot. Lapok, 29: 58-104.
Vodenicharov D, Dimitrova-Konaklieva S, Ivanov D, Kirjakov I, Mladenov R, Moncheva S, Petrov S, Temniskova-Topalova D. 1993. Biological diversity of Bulgaria – algae, bryophytes, aquatic plants (hydathophytes, neistophytes, helophytes), lichenized fungi. – In: Sakalyan M. (ed.), National Strategy for Conservation of the Biological Diversity, Pensoft, Sofia-Moscow. p. 35-72. (In Bulgarian)
Wijayawardene NN, Hyde KD, Lumbsch TH, Liu, JK, Maharachchikumbura SSN, Ekanayaka AH, Tian Q, Phookamsak R. 2018. Outline of *Ascomycota*: 2017. Fung. Div., 88(1): 167-263.
Zhelezova B. 1956. Contribution to the lichen flora of Bulgaria. Izv. Bot. Inst., 5: 387-403. (In Bulgarian)
Zhelezova B. 1960. Contribution to the lichen flora of Bulgaria. Izv. Bot. Inst., 7: 351-357. (In Bulgarian)
Zhelezova, B. 1963. Materials on the lichen flora of Bulgaria. Izv. Bot. Inst., 12: 245-265. (In Bulgarian).